Seasonal Trends in Vehicle Emissions

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Vehicle emissions as measured by several state I/M programs vary by season. Figure 1 shows the daily average CO of initial IM240 tests of Arizona passenger cars over a three year period (filled circles, left scale). (Emissions of cars that are fast-passed or fast-failed are adjusted to their full IM240 equivalents.) The trend in the maximum daily temperature is also shown (gray lines, right scale). The solid vertical lines denote the calendar years, whereas the dashed vertical lines denote the changes in fuel composition. CO, and HC (Figure 2), are higher in Phoenix in the warmer summer months; on the other hand, NOx shows the opposite seasonal trend, and is higher in winter months (Figure 3). Colorado IM240 data show similar seasonal patterns (Figures 4 through 6).

It is unclear whether the seasonal variation is due to a combination of ambient temperature and changes in fuel composition, or to inadequate conditioning of vehicles prior to testing. Average emissions of MY90 and newer passenger cars that pass their initial I/M test, and therefore would be less likely to be effected by inadequate preconditioning, exhibit the same, albeit muted, seasonal trends in emissions. The seasonal variation in Arizona remote sensing (Figure 7) and loaded idle (Figure 8) CO data appears to mirror that of the Arizona IM240 emissions, suggesting that vehicle conditioning is not the cause of the variation. (The loaded idle data for MY81 and newer passenger cars are taken from the Basic I/M program in Pima County.) However, the seasonal variation in CO (Figure 9) and HC (Figure 10) in the Wisconsin IM240 program and the variation in CO in the Minnesota idle program (Figure 11) are in the opposite direction: CO and HC are higher in winter months. (The extremely high CO values in Minnesota in Figure 11 are likely due to the small number of vehicles tested in these months.) The seasonal NOx trend in Wisconsin, Figure 12, follows that of Arizona and Colorado. A possible cause of the different in the Wisconsin trend from the other states is the use of year-round RFG in the Wisconsin area; however, RFG was introduced in Arizona in late 1997, with no apparent effect on the seasonal variation in emissions. More analysis is needed to better understand these seasonal trends, and why they differ by area.

Figure 1. Daily Average CO, Arizona IM240

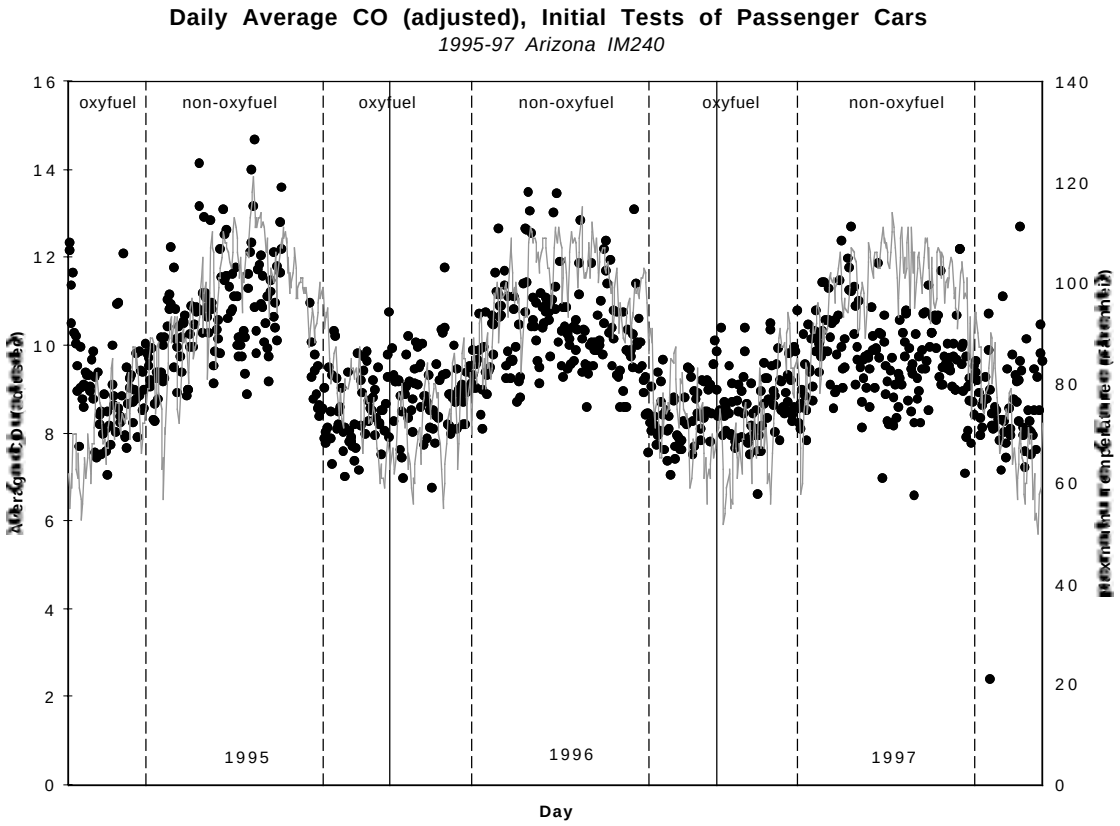

Figure 2. Daily Average HC, Arizona IM240

Daily Average HC (adjusted), Initial Tests of Passenger Cars

1995-97 Arizona IM240

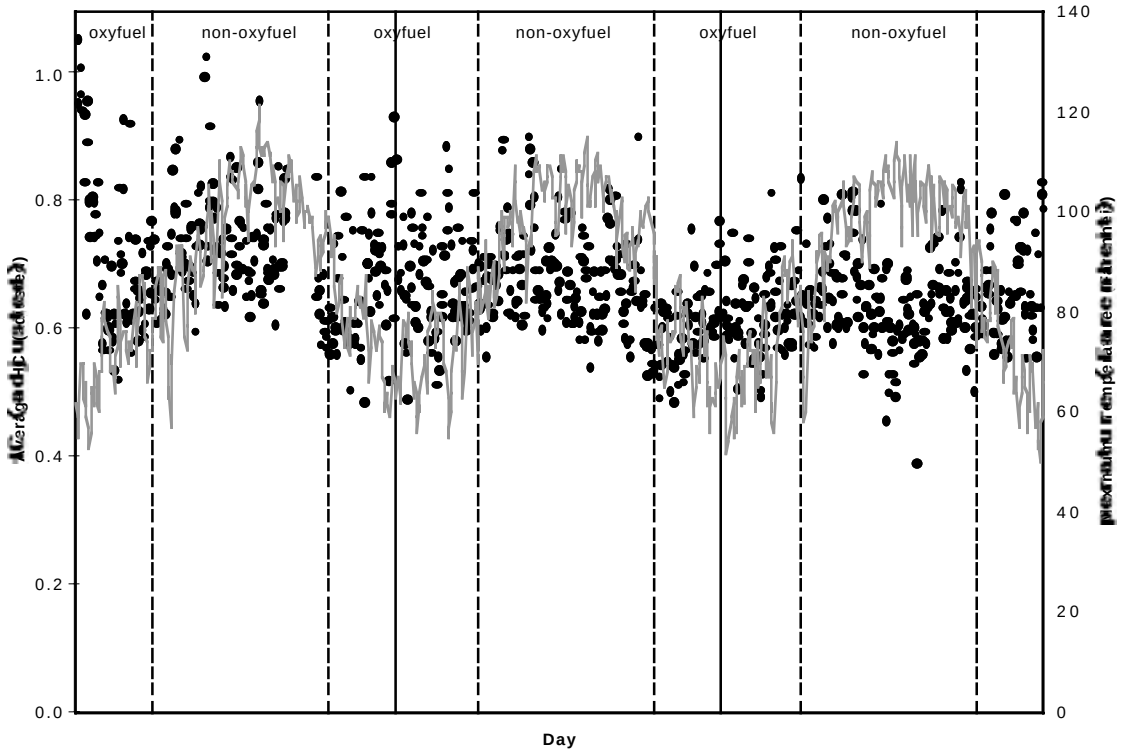

Figure 3. Daily Average NOx, Arizona IM240

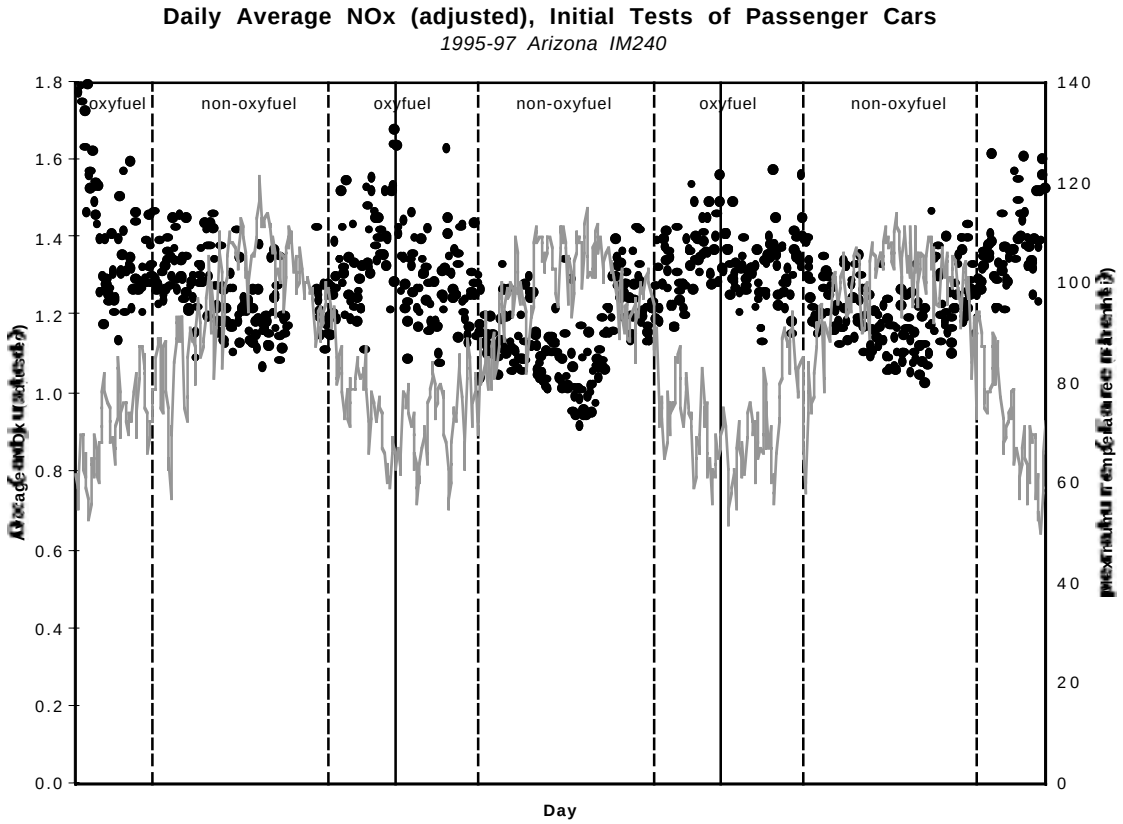

Figure 4. Daily Average CO, Colorado IM240

Daily Average CO, Initial Tests of Passenger Cars

1995-97 Colorado IM240

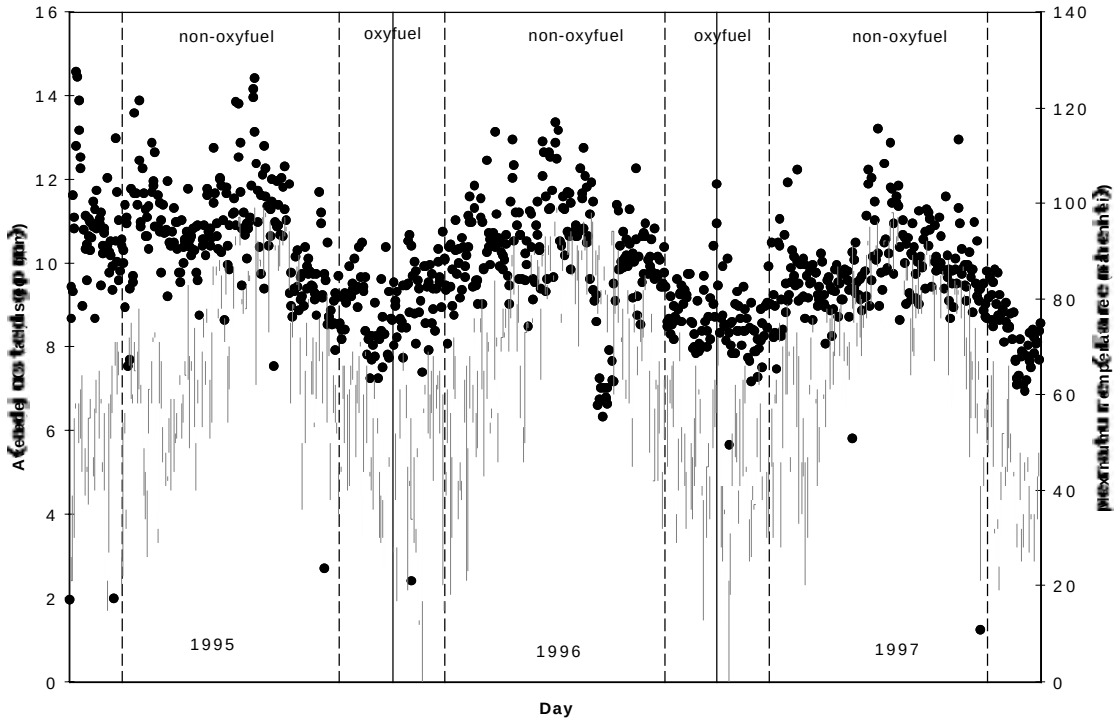

Figure 5. Daily Average HC, Colorado IM240

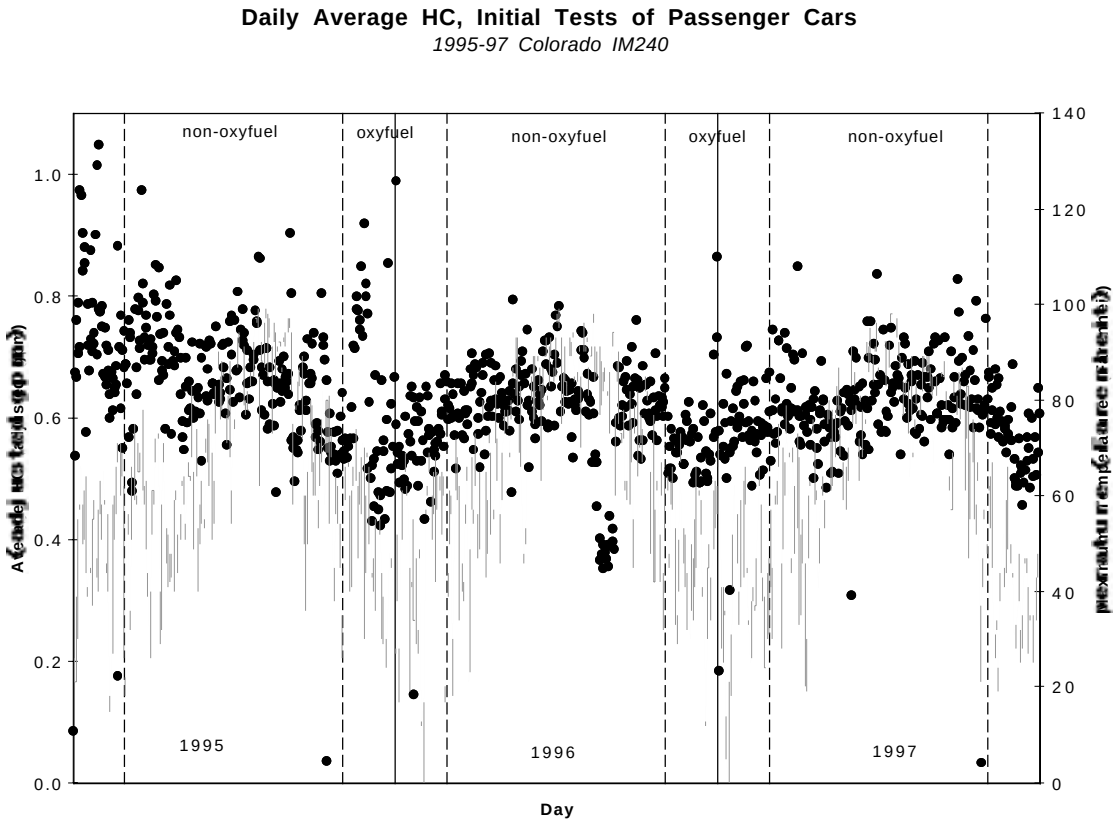

Figure 6. Daily Average NOx, Colorado IM240

Daily Average NOx, Initial Tests of Passenger Cars

1995-97 Colorado IM240

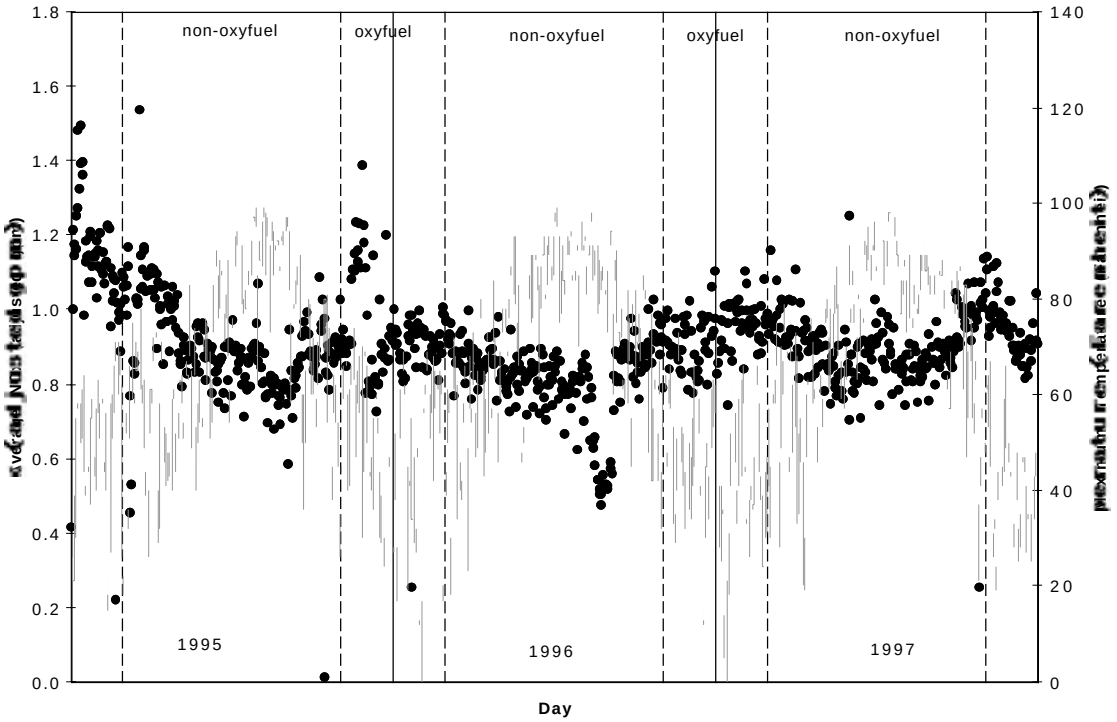

Figure 7. Daily Average CO, Arizona Remote Sensing

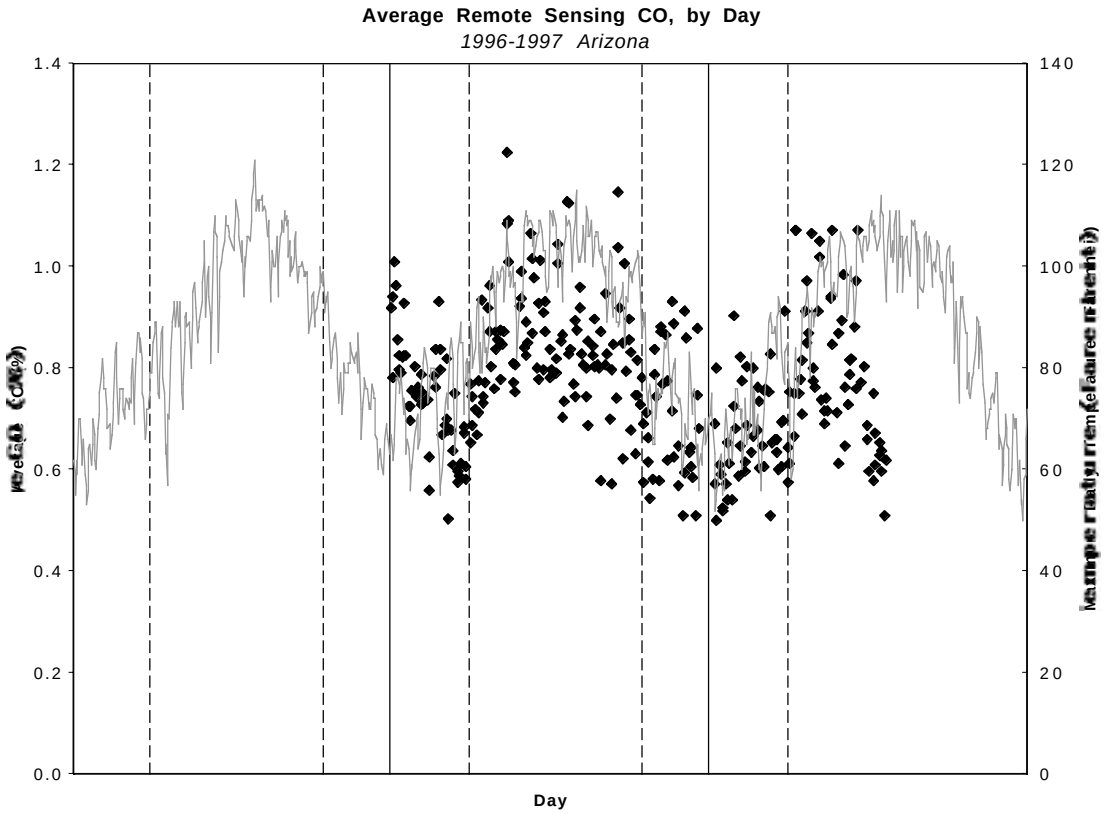

Figure 8. Daily Average CO, Arizona Loaded Idle (Pima County)

Average Loaded Idle CO, by Day

1995-97 Arizona Loaded Idle

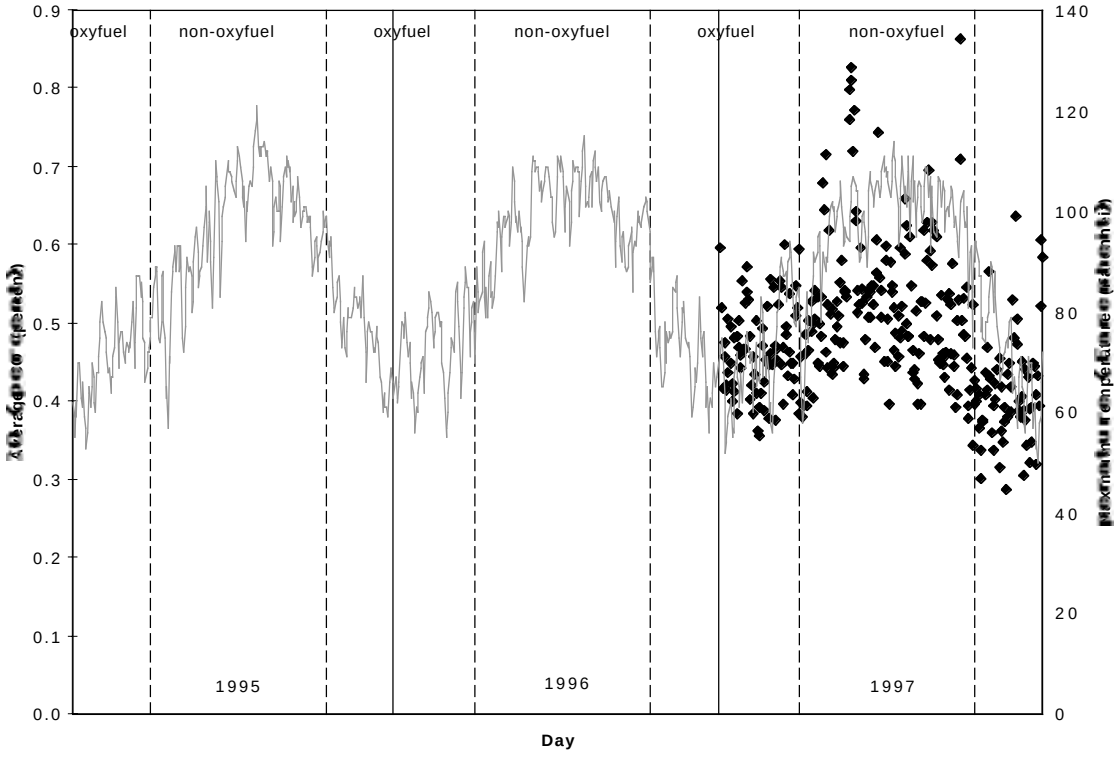

Figure 9. Daily Average CO, Wisconsin IM240

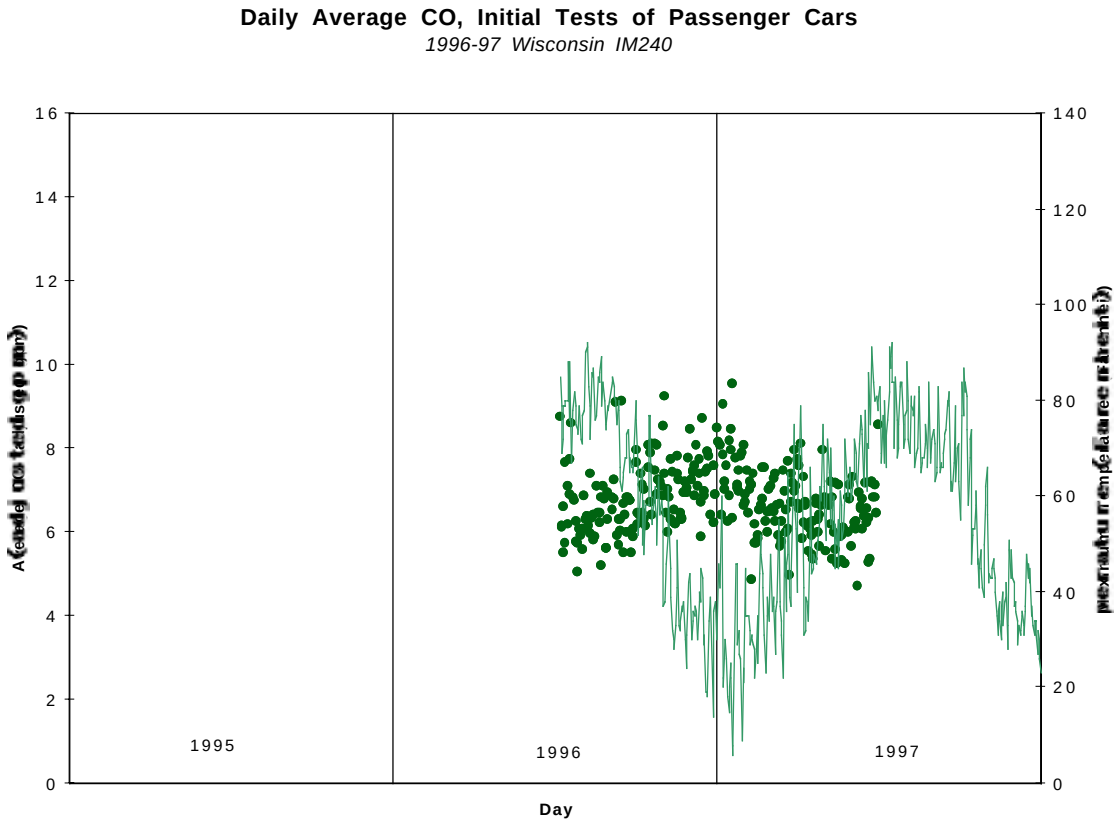

Figure 10. Daily Average HC, Wisconsin IM240

Daily Average HC, Initial Tests of Passenger Cars

1996-97 Wisconsin IM240

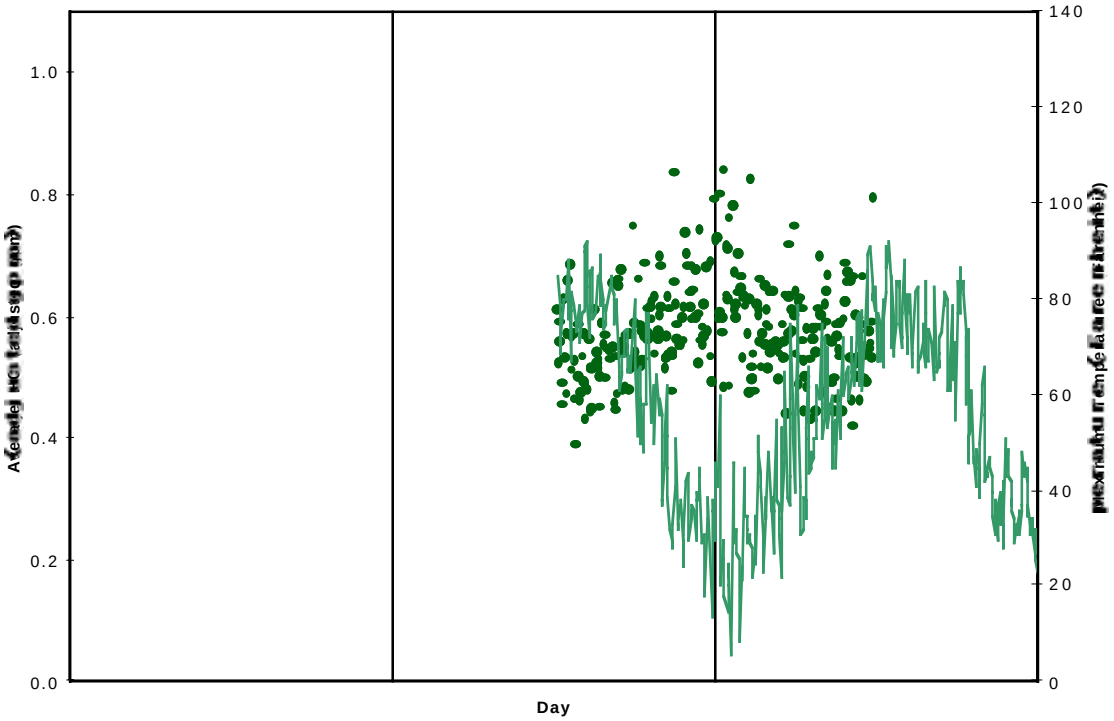

Figure 11. Daily Average CO, Minnesota Idle

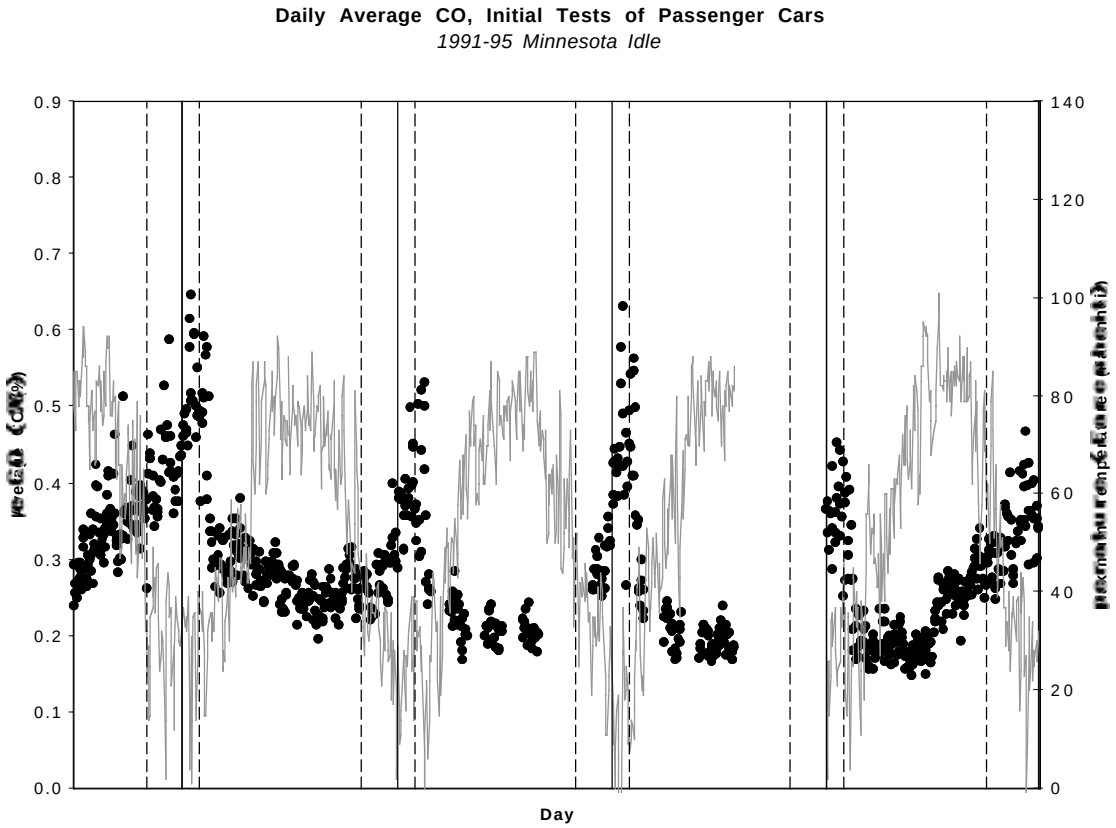

Figure 12. Daily Average NOx, Wisconsin IM240

Daily Average NOx, Initial Tests of Passenger Cars

1996-97 Wisconsin IM240